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summer's night. But the line sketched out by Professor Brackett offers, we think, only a very slender hope of accomplishment.

**NEW SECONDARY BATTERIES.** — Hardly a week passes but we read of some new secondary battery that is to be introduced. This state of affairs has a promising side and an unpromising one. It shows the great need of some reliable storage-battery, and it brings out the fact that a great number of people are working at the problem of finding one. Some of these new cells compare very favorably with the older and better-known types; some of them are, in all probability, not so good. One of the newest is the Johnson battery, which is to be manufactured in Boston. Special advantages are claimed for it, but no figures are given, nor is it anywhere fully described. Two other batteries have been recently put on the market, — the Macrean and the Detroit. We hope to publish some figures as to the latter at an early date: it is a promising type of cell. It is to be hoped that a year which opens with such activity in storage-battery circles will develop some cell that will make electric traction in our crowded cities practicable.

**IS A VACUUM AN ELECTRIC CONDUCTOR?** — Some time ago M. Foeppel made some interesting experiments on the conductivity of a vacuum; his results tending to show that a vacuum is an insulator, or, at best, its conducting-power is very small. The experiment has been described in this journal. Briefly it consisted in making a galvanometer whose coils were made of glass tubing from which the air had been exhausted, and connecting it with the secondary of an induction-coil, also constructed of glass tubing. There was no inductive effect observed when a current was sent through the primary of the coil, even when the electro-motive force induced had a value of 5,000 volts. M. Foeppel concluded then that an absolute vacuum would be a non-conductor, and that ordinary vacuum-tube phenomena are caused by convection. Some of his more recent experiments tend to throw some doubt on these conclusions. He placed an exhausted tube within a solenoid through which he sent a Leyden jar discharge. Luminous phenomena took place, as in an ordinary vacuum tube provided with electrodes, at which an electro-motive force is applied. We know so little, however, of the nature of luminous discharges in vacua, that we can hardly consider the evidence of the last experiment so strong as that of the first; and while it may be possible to account for either result on the hypothesis of the non-conduction, or on that of the conduction of a vacuum, the former seems much the more probable.

**ELECTRIC LIGHT IN THE PATENT OFFICE.** — From the report of the secretary of the interior, we learn that arrangements were made the past year with the assistance of Lieut.-Commander Bradford of the United States Navy (among the most expert of electricians), with the Brush Electric Light Company of Cleveland, O., for the construction of the necessary machinery, and the arrangement of wires, appliances, and lamps, for the Patent Office building, in order to light it completely. The department will be able to furnish its own light at so great a diminished cost, that it is believed the saving from the average annual outlay heretofore sustained will in three years reimburse the expenditure for the plant. There are such vast piles of public papers, records, and documents in the various rooms, halls, and cellars of the department, many of these so dark as to require light throughout the day, that a mode of illumination which is consistent with their safety becomes of prime importance. It is believed that this object has been most satisfactorily secured by the arrangements made under the direction of Lieut.-Commander Bradford. Secretary Vilas avails himself of the opportunity to express his sense of obligation for the great advantage enjoyed in the generous contribution of Lieut.-Commander Bradford's expert and valuable knowledge, from which he believes the electrical equipment of the department will hardly be equalled in the country for safety and efficiency, procured upon the most economical terms.

PROFESSOR N. S. SHALER of Harvard University is in Washington, on his way to the Dismal Swamp. He will there spend a fortnight in geographical and geological researches, in order to complete an article for the next annual report of the Geological Survey.

## THE OBSERVATORY HILL RAILWAY OF ALLEGHENY CITY, PENN.

THIS railway has been in continuous operation since January, 1888, as an electric road. The line is about four miles in length. For one-fourth of this distance the electric conductors are contained in a sub-surface conduit. For the remainder of the line the conductors are elevated above the roadway, being bracketed off from poles erected along one side of the street. The conduit branches from double to single track, and at the present terminus of the line there is a conduit cross-over switch from down to up track. At different points along the conduit section the conduit cuts through five other street-railway tracks belonging to other companies.

On the elevated conductor section the line is single track with seven turn-outs. Double conductors are used throughout both conduit and elevated conductor sections, neither the rails nor any part of the conduit itself being used as a part of the electric circuit.

Nowhere throughout the whole line is there a space fifty feet long where a car will stand without the brakes being applied. There are thirty-four curves on the line, not including turn-outs or switches. The maximum grade is  $12\frac{1}{2}$  feet in 100 feet. There is a total rise of 295 feet in 4,900 feet, with an average of about six per cent. The maximum grade of  $12\frac{1}{2}$  is on a reversed curve (radii 100 and 200 feet). The sharpest curve has a 35-foot radius on five-per cent grade.

The Bentley-Knight conduit system consists of a power station, — engines, boilers, and dynamo-electric machines; a conduit running the whole length of the line, containing the conductors which convey the electric current to the motors; and hanging connections (ploughs) which pass through the conduit slot, and, sliding along the conductors, maintain unbroken connection between the motors and the source of power. The electric conductors are accessible only to regular employees, furnished with special tools, while the current used, even in roads of the heaviest carrying capacity, cannot injure either life or property.

The conduit, which contains the conductors and supplies the current to the motors along the line, can be placed at any point where the opening of the slot will be below any part of the car-body. In constructing a conduit line, the iron yokes shown in the accompanying figure are set up from four to six feet apart, and the conductors set against the insulators which support them at each yoke. The electrical connection between the different lengths of conductor are then made, the slot-steels set on the yokes, and the slot-steels and yokes firmly bolted together, leaving a slot opening at the surface of the street of only five-eighths of an inch. Attention is especially directed to that form of Bentley-Knight conduit which permits the width of the slot to be regulated, the slot rails to be removed, and the conductors, insulators, and interior of the conduit to be inspected, without disturbing the pavement. The conductors are copper bars connected by expansion joints, and are of sufficient size to carry the current with a loss never greater than five per cent. The fact that the conduit can swerve from a straight line to avoid obstructions, and can be laid outside of the track wherever desired, greatly decreases the expense and difficulty of laying.

Electrical connection between the motor and the conductors in the conduit is effected by a contact-plough, which consists of a flat frame, hung from the car by transverse guides (on which it is free to slide the whole width of the car), and extending thence down through the slot of the conduit. It is so constructed as to adjust itself to all inequalities of road or conduit. This frame carries two flat insulated conductor-cores, to the lower ends of which are attached, by spring hinges, small contact-shoes, which slide along in contact with the two conductors in the conduit. At the upper ends are attached connections leading to the motor. This plough can be inserted or withdrawn through the slot at will, the spring hinges allowing the contact-shoes to straighten out into line with the conductor-cores when the plough is pulled upward. By no accident, therefore, can any thing be left behind in the conduit to obstruct succeeding cars. The plough-guides are hung on transverse axes, and are held in a vertical position by a spring-catch that gives way when the plough meets an irremovable obstruction, and allowing the plough to be thrown completely out of the conduit without injury, it being also immediately replaceable. The frame of the

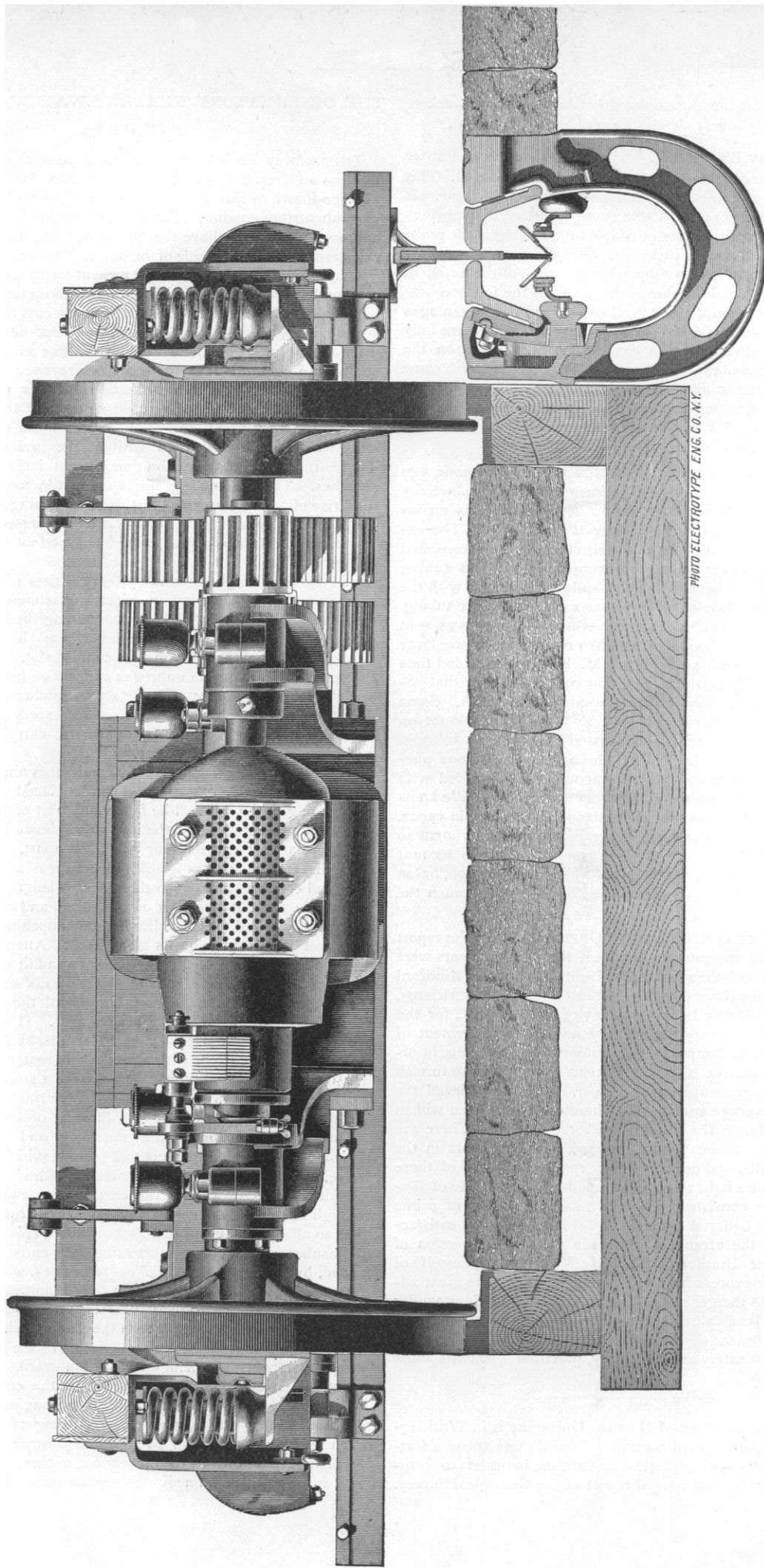
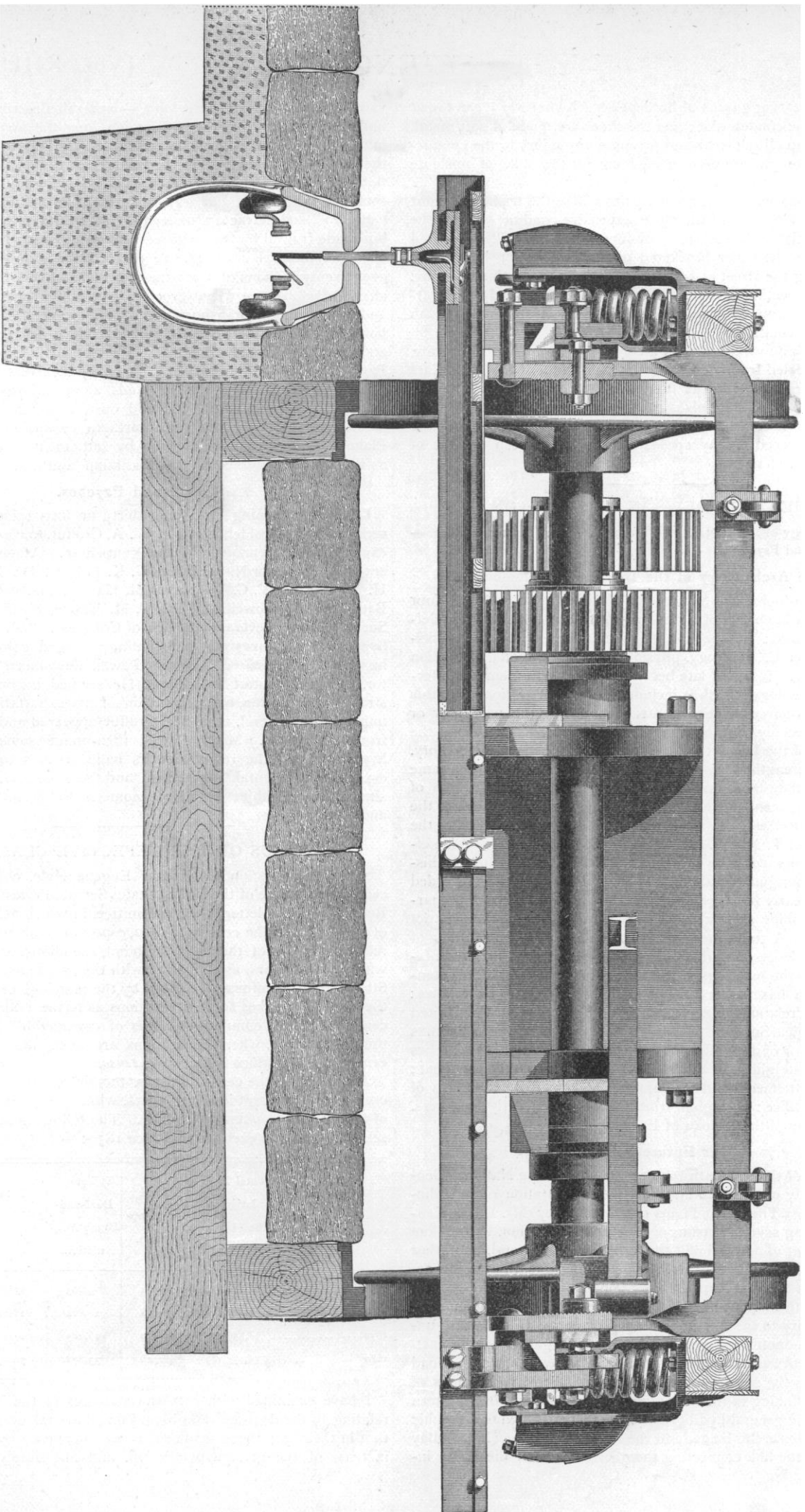


PHOTO ELECTROTYPED ENG. CO. N.Y.

BENTLEY-KNIGHT STANDARD MOTOR TRUCK, CONDUIT, AND PLOUGH (FRONT VIEW).



BENTLEY-KNIGHT STANDARD MOTOR TRUCK, CONDUIT, AND PLOUGH REAR VIEW.

plough has wearing guards of hardened steel wherever it can touch the edge of the conduit slot; and the shoes are made of soft metal, which takes up all the wear and prevents any injury to the conductors. Two ploughs are used on each car for the sake of absolute reliability.

For suburban lines, or for small cities where the traffic does not justify the employment of the more expensive conduit system, the company furnishes its elevated conductor system. The elevated conductors can be either bracketed off from poles, or hung from wires crossing the street at any desired height above the roadway. Electrical connection between the motor on the car and the elevated conductors is maintained by means of a trolley or contact-brush and a flexible conductor.

The motor and mechanism of a car operate noiselessly, and are entirely concealed from view beneath the bottom of the car. Cars may be stopped as quickly as desired, may reverse at will, and, if derailed, can propel themselves back on the track.

The motor is controlled from either end of the car; and the driver may proceed at any speed, from a slow creep to that of twenty miles an hour.

#### SCIENTIFIC NEWS IN WASHINGTON.

The Archæology of the District of Columbia. — Our Future Empire. — Science and Psychos.

##### The Archæology of the District of Columbia.

THE Anthropological Society of Washington consists of four sections, each in charge of a vice-president, but none thus far definitely organized: viz., Section A, somatology; Section B, sociology; Section C, philology, physiology, and psychology; Section D, technology. It has of late become apparent to members interested in archæology (which is included in the last section) that this subject has received inadequate attention during the past year or two, and especially that too little attention has been given to the archæology of the District of Columbia and contiguous territory. In order to strengthen this branch of anthropology, and at the same time to stimulate local investigators, a temporary organization of Section D has been effected. At a meeting of the members of the society interested in local work, called by the vice-president of the section, Dr. O. T. Mason, last week, it was decided to combine efforts and results, with the immediate object of elucidating the history of the aboriginal inhabitants of the Potomac River as recorded in relics and early writings, and with the ultimate object of preparing and publishing a monograph on the antiquities of the District of Columbia. A committee was appointed to prepare *résumés* of existing knowledge on various phases of the subject for presentation at one of the meetings of the society in April next. This committee, which has power to add to its numbers, is as follows: geology in its relations to early man, W. J. McGee of the United States Geological Survey; paleolithic man and his remains, Thomas Wilson, curator of antiquities of the Smithsonian Institution; relics of the later aborigines, S. V. Proudfit of the Interior Department; prehistoric settlements and workshops, Dr. Elmer R. Reynolds of the Pension Office; aboriginal tribes recorded by early explorers, James Mooney of the Bureau of Ethnology.

##### Our Future Empire.

The event of the sixteenth regular meeting of the National Geographic Society on the 11th inst. was the presentation of an elaborate paper on "The Great Plains of Canada," by Mr. C. A. Kenaston. During several seasons of constant exploration, undertaken with the object of ascertaining the agricultural, pastoral, and other capabilities of the country, Mr. Kenaston became thoroughly acquainted with the vast expanse of plain country stretching from Hudson Bay to the foot-hills of the Rockies, and from the international boundary to the Arctic Circle. The entire tract is one uninterrupted, monotonous, grassy plain, sloping gently to the eastward and northward, diversified only by shallow lakes and broad water-ways in the east, and by shallow but steep-sided cañons of the rivers beginning in the mountains in its central and western portions. The general hydrography, the more detailed topographic features, the flora, the fauna, and the *voyageurs* of the Hudson Bay Company, — the link connecting the aborigines with the white in-

vaders who now possess the land, — were all described at length; and it was pointed out that this region, long the home of the buffalo, the wolf, the badger, and uncounted myriads of wild fowl, is the American wheat-field of the future. In the south-eastern portion of the tract the soil is a dark prairie loam, like that of Minnesota and Iowa; west and north-west of it lie millions of acres of "gumbo" soil, refractory under the first efforts of the agriculturist, but made fruitful by two or three seasons of tillage; while the soil of the northern plains is a fertile yellow loam or boulder drift; and over twenty millions of acres the conditions of soil and climate are alike so favorable to wheat-growing, that only peopling by farmers and the opening of transportation routes are needed to make any part of it successfully rival the famous wheat-fields of Minnesota and Dakota. Already the tract is intersected by the Canadian Pacific and many other railways, the navigable rivers are being supplied with steam-craft, and the lands along railways and waterways are generally sectionized and open to occupation; and the present prospects are that this northern expansion of the Great Plains of America will be overrun by settlement nearly as rapidly as was the part drained by the Mississippi and its tributaries.

##### Science and Psychos.

On Friday evening last, some thirty or forty scientific men assembled at the residence of Mr. W. A. Croffut, to "assist" at some experiments in hypnotism by that gentleman. Among those present were Professor N. S. Shaler, G. K. Gilbert, Dr. T. N. Gills, A. H. Thompson, W. C. Winrock, Col. Garrick Mallery, Gen. Adam Badeau, Major Powell, and Mr. F. M. Thorn, chief of the Coast Survey, besides several members of Congress. While one of the hypnotized sensitives was personating an aged colored preacher, he was violently seized by Major Powell, denounced as an impostor, and thrust out of the room. He seemed unconscious of the strange interruption, and the stream of his exhortation flowed on unbroken to the end, until Mr. Croffut appeared and recalled him from the trance. Major Powell then made some remarks on hypnotism and the relation of its hallucinations to other states, especially to mental abstraction and heterophemy, and the desirableness of subjecting its phenomena to scientific conditions and observation.

##### CENSUS OF THE DEFECTIVE CLASSES.

At the suggestion of Senator Eugene Hale, chairman of the census committee of the United States Senate, Professor A. Graham Bell addressed a letter to the committee, in which he refers to some of the results of the census of 1880, especially with reference to the relative increase of the deaf, the blind, the idiotic, and the insane within recent years, as compared with the population in the United States, and to deafness as caused by the marriage of the deaf with the deaf, and makes some suggestions as to the taking of the next census. As this communication is of considerable importance at the present time, when preparations are being made for the next census, we reproduce it here *in extenso*.

According to the census returns, the defective classes have increased 400 per cent in thirty years, while the general population of the country has simply doubled. The following table shows the relative figures at each census since 1850:—

Years.	Total Population of the United States.	Total Blind Population.	Total Deaf-and-Dumb Population.	Total Idiotic Population.	Total Insane Population.
1850.....	23,191,876	9,794	9,803	15,787	15,610
1860.....	31,443,321	12,658	12,821	18,930	24,042
1870.....	38,558,371	20,320	16,205	24,527	37,432
1880.....	50,155,783	48,928	33,878	76,895	91,997

I have examined with care the statistics of the Tenth Census relating to the deaf-and-dumb, and find internal evidence to show that in their case there has been a real increase greater than the increase of the general population, and not simply an apparent